
# FRA T16

# ATIP

## AUTOMATED TRACK INSPECTION PROGRAM

UNITED STATES DEPARTMENT OF TRANSPORTATION
FEDERAL RAILROAD ADMINISTRATION
OFFICE OF SAFETY ASSURANCE AND COMPLIANCE

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

# TRACK GEOMETRY MEASUREMENT FOR TODAY'S RAILROAD SYSTEMS

## INTRODUCTION

The primary mission of the Federal Railroad Administration (FRA) is to ensure railroad safety. To accomplish this, we set and enforce safety standards, investigate major train accidents, and assist the rail industry in training its workforce on safety laws. To provide a balanced transportation system, the FRA Office of Safety Assurance and Compliance, is responsible for inspecting, monitoring and directing safety improvements at grade crossings, railroad trackage and railroad vehicles operating over the nation's general transportation system.

The national deployment of the Automated Track Inspection Program (ATIP), track geometry vehicle serves an important role in FRA's overall compliance programs. The Office of Safety objective is to conduct safe, accurate, and efficient surveys with the foci to develop a comprehensive automated inspection supplement that may eventually go beyond manual inspection imprecision by improving the method and practice of measuring substandard track conditions.

ATIP's function is to minimize the risk of a passenger or catastrophic hazardous material accident/incident by continuously improving the geometry vehicle's operational efficiency, insuring measured and recorded values accurately represent track conditions, and timely distributing track geometry information to FRA headquarters, regional management, and respective railroad personnel (Figure 1).

The primary safety-related use of ATIP is the assistance provided to FRA inspectors in identifying the most important track locations and conditions for them to evaluate. Key to ATIP's safety success is the advance detection of potential accident-causing hazards and the appropriate basis for inspectors to impose and safeguard rail transportation with compulsory operational and maintenance remediation.

FRA's track geometry survey vehicle (FRA T16) helps America's railroads increase safety and keep pace with advancing technology. The data, produced by the car through the precise measurement of existing track systems, are used to monitor compliance with federal safety standards and aid in the efficient, effective track system maintenance planning to support the engineering of today's energy efficient, high speed railroads.

FRA relies on ATIP data as a primary tool for headquarter and regional managers to; (1) monitor and assess railroad compliance with the *Federal Track Safety Standards* (FTSS), (2) evaluate, as an early indicator of the safety trends within the industry, and (3) create a centralized Track Data Management System (TDMS) archive to support special safety studies, including accident/incident investigations, congressional, and public requests. Additionally, the TDMS database maybe used to set priorities for enforcement activities, compliance agreements, perform quality assurance checks for the geometry vehicle and to evaluate the effect of proposed changes in the FTSS.

The onboard measurement and geographic reference systems also make ATIP a valuable tool for the inventory of track structures (*e.g.*, turnouts, at grade railroad crossings and highway-rail crossing's locations), exception analyses, and convenient access to historical data for particular-surveyed railroad.

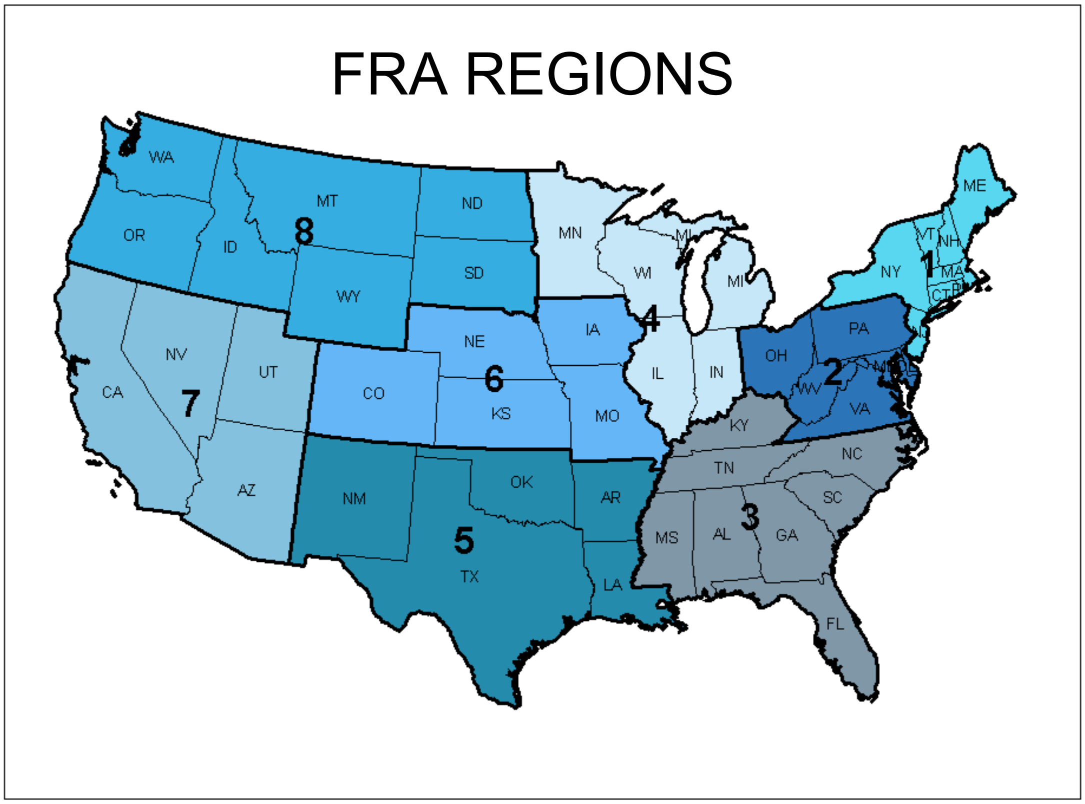



Figure 1

- FRA's T16 vehicle is headquartered in Washington, DC.  The Federal Railroad Administration, Office of Safety is responsible for the planning, direction and control of all aspects of the Automated Track Inspection Program.

- Surveys are scheduled according to current FRA priorities.

- Each of the eight regions assigns Federal Track Inspectors to the vehicle as it travels through the Region's Territory.

- State Track Inspectors augment the FRA team and inspect track within their respective states.

| | Regional Office | Phone # | States in Region |
|---|---|---|---|
| Region 1 | Cambridge, MA | (617) 494-3989 | CT, ME, MA, NH, NJ, NY, PA, RI, VT |
| Region 2 | Lester, PA | (610) 521-8200 | DE, MD, NJ, OH, PA, VA, WV |
| Region 3 | Atlanta, GA | (404) 562-3817 | AL, FL, GA, KY, MS, NC, SC, TN |
| Region 4 | Chicago, IL | (312) 353-6203 | IL, IN, MI, MN, WI |
| Region 5 | Hurst, TX | (817) 862-2200 | AR, LA, NM, OK, TX |
| Region 6 | Kansas City, MO | (816) 329-3840 | CO, IA, IL, KS, MO, NE |
| Region 7 | Sacramento, CA | (916) 498-6547 | AZ, CA, NV, UT |
| Region 8 | Vancouver, WA | (360) 696-7536 | AK,ID, MT, OR, ND, SD, WA, WY |

## PRINCIPAL OPERATION

Safety onboard an FRA geometry vehicle and on the ground is of the utmost importance. Safe ATIP operations are the responsibility of FRA and contractor personnel, and, as such, they are held accountable for the control, authority, and enforcement of this policy. On behalf of the FRA, a contractor operates and maintains the government-furnished geometry vehicle safely efficiently, and accurately records track geometry data, performs the necessary adjustments towards corrective and preventive maintenance work, and all other activities required to keep the geometry vehicle's equipment and instrumentation in an operational, safe, clean, and orderly condition.

In addition, the contractor assures continuous quality improvement in service and technology to assist inspectors in fostering the identification and evaluation of geometry exception locations and conditions. A normal survey (testing) begins each day at 8:00 a.m. All assigned personnel will report promptly, at the designated on-duty time and location, to avoid a delayed departure.

Anywhere the geometry vehicle operates, onboard instrumentation always records track geometry measurements. Currently, an active survey status cycle consists of *four-weeks* of operations, (*i.e.,* Monday through Friday) followed by a weekend day to perform minor corrective or preventive maintenance and housekeeping, usually an 8-hour period. However, special assignment surveys maybe scheduled according to a specific occurrence and could last only a day or two in duration.

## CLASS OF TRACK

The FTSS are contained in 49 Part 213 *Code of Federal Regulations* (CFR) and divide railroad track into nine (9) speed-related classifications, ranging up to 200 miles per hour. Permissible variations of track geometry are given for each track class. FRA delegates approximately 90 Federal track safety inspectors and 30 certified State inspectors, to monitor and assess railroad track compliance, and track owner maintenance records and safety procedures. The *Federal Track Safety Standards* are based upon <u>authorized</u> speeds for passenger and freight trains. When FRA and participating State Inspectors, inspect track for compliance [they] accept the introductory train speed information from the individual railroad. Consequently, this posted timetable speed establishes the basis for inspectors to view a track segment according to its design characteristics

FRA regulates train speed in two ways; the <u>presence, or absence of a signal system</u> and the <u>physical and geometry condition or quality of the track structure.</u> For example, regarding signal systems, if both passenger and freight trains were operated, FRA signal rules would limit the speed to 59 and 49 miles per hour, respectively, with no basic signal system in place. With a <u>basic</u> signal system in place, speed for all types of train equipment would be limited to 79 miles per hour.

FRA regulates railroads a <u>second</u> way by prescribing speed limits according to the specific geometry and physical track structure conditions existing in isolation. These minimum safety standards are often exceeded by railroads, which adopt more stringent safety requirements. Railroads are obligated to keep the track in compliance with the FTSS based on its design characteristics.

Geometry and structural tolerances specified in the FTSS are grouped (Table 1) according to a speed focused *'Class of Track'*. Deviation beyond the limiting parameters requires repair or reducing train speed to the appropriate 'class'. FRA regulations define nine (9) classes of track.

A segment of track must meet all of the requirements for its intended class, *i.e.*, geometry, crosstie and rail specifications, etc. Track classes are based upon maximum speed ranges of 10 through 200 miles per hour, that is, Class 1 track is the lowest speed upward to Class 9, and the highest speed trains are permitted to operate, respectively.

In other words, as train speed increases, track safety requirements become more restrictive. Train speed is only contingent upon the level of construction and maintenance a railroad places in its track toward a nationally uniform maximum limit. Through inspections, FRA and State safety inspectors daily ensure railroads are operating their trains according to the Federal regulations.

**Class of Track: Operating Speed Limits Subpart A-F**

| **Over track that meets all of the requirements prescribed in this part for…** | **The maximum allowable speed for freight trains is…** | **The maximum allowable speed for passenger trains is…** |
|---|---|---|
| Excepted Track | 10 | Not applicable |
| Class 1 Track | 10 | 15 |
| Class 2 Track | 25 | 30 |
| Class 3 Track | 40 | 60 |
| Class 4 Track | 60 | 80 |
| Class 5 Track | 80 | 90 |

**Class of Track: Operating Speed Limits Subpart G**

| Over track that meets all of the requirements prescribed in this subpart for… | The maximum allowable operating speed for trains[1] |
|---|---|
| Class 6 Track | 110 |
| Class 7 Track | 125 |
| Class 8 Track | 160[2] |
| Class 9 Track | 200 |

Table 1

## SURVEY EXCEPTIONS

Ideally, railroad tracks are perfectly uniform. In practice, however, weather and geographical conditions, train speeds, tonnage, and continued maintenance requirements contribute to railroad track non-uniformities and, in some cases, exceptions. FRA developed the high-speed track geometry vehicle FRA T16 to detect non-uniformities and identify specific track conditions. When FRA T16 measures track, sensors mounted on the vehicle generate electronic voltages. These voltages are collected at sample intervals of one foot, conditioned, and input to a data acquisition system.

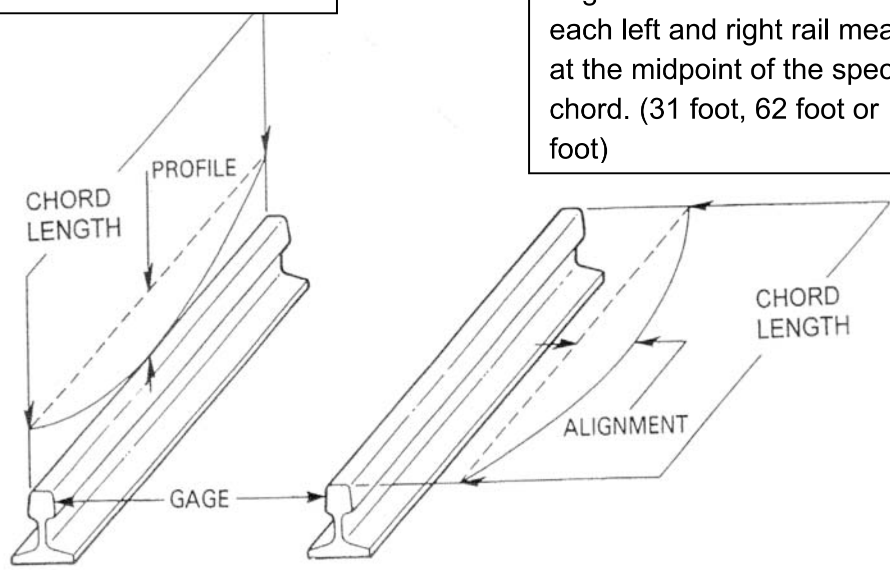
[1] Refer to §213.307 regulatory text
[2] Refer to §213.307 regulatory text

Track geometry parameter values are the product of complex calculations performed using variables (input voltages from instrumentation) and constant values. The products of these calculations represent information relating to the geometry of the track that can have positive or negative values or polarity. The data acquisition system consists of several networked microcomputers, equipped with analog-to-digital converters, disk drives, laser printers, and automatic and manual data entry devices. Several output devices are available including three oscillograph, video displays, and CD-ROM.

The data acquisition system processes the signals into track geometry parameters. Geometry parameters are compared to limits prescribed in the FTSS, which establish the maximum allowable speed for trains. The geometry vehicle's onboard TGMS instrumentation performs automated, analog signals, which are processed on-line by a computer and sustain a graphical record of detailed track geometry conditions, including delimiting measurements.

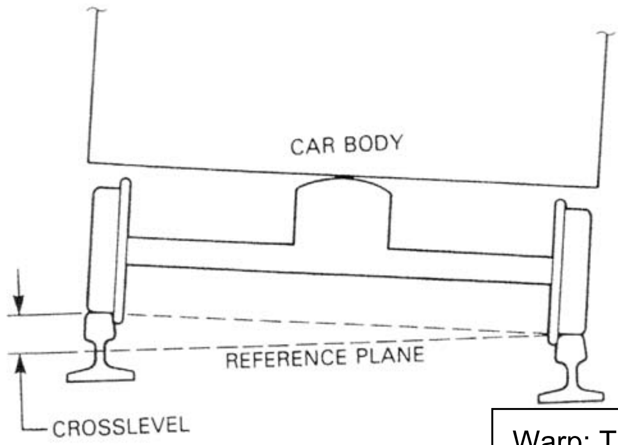
Profile: The surface uniformity of each left and right rail measured at the midpoint of the specified chord. (31 foot, 62 foot or 124 foot)

Alignment: The line uniformity of each left and right rail measured at the midpoint of the specified chord. (31 foot, 62 foot or 124 foot)



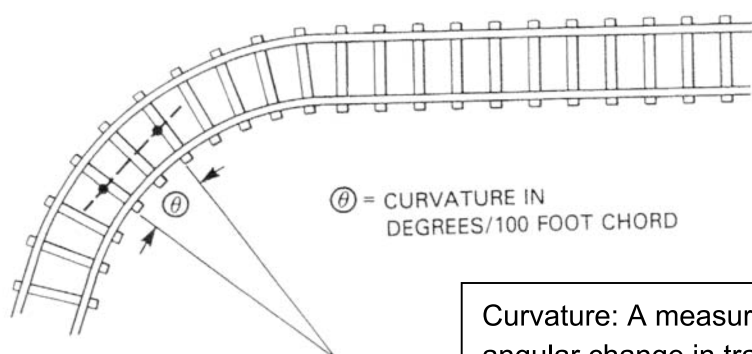

Gage: The distance between the rails measured five-eighths of an inch below the top surface of the rail.

Figure 2




Warp: The Deviation in Crosslevel between any two points less than 62 feet apart and derived from Crosslevel measurements. (Not illustrated)

Crosslevel: (Super-elevation) The amount of elevation of one rail above the other



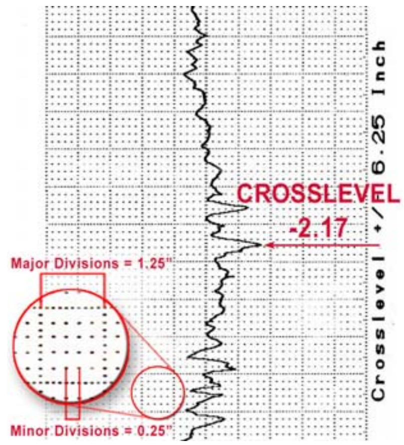

Curvature: A measure of the angular change in track direction per 100-foot track chord.

Rock-Off — A condition caused by regularly spaced, consecutive low joints. At low speeds, causes cars to rock. If severe can cause derailments by "Rocking Off" certain cars. Derived from Crosslevel. (Not illustrated)

Figure 3

**DESCRIPTION OF PARAMETERS**
The processor controls the data sampling of all analog and digital sensors required for track geometry measurements. Sensor outputs are combined by analog and digital calculations to arrive at the desired parameters. The track geometry processor also provides synchronization to all other time and distance based measurement systems. Track geometry measurement involves the following real-time track geometry parameter descriptions and operating requirements:

***Crosslevel*:** The system determines track crosslevel on tangent track and Superelevation on curved track by measuring the inclination angle of a loaded axle. The system first establishes the inclination of the car-body with a compensated accelerometer system (CAS). A CAS sensor package, consisting of an inclinometer, a fiber optic gyro (FOG) yaw and roll rate gyro, is mounted on the measurement beam of the FRA T16. Algorithms implemented in a combination of analog and digital schemes are used to process the CAS signals and yield the inclination of the car-body. Compensations are made to correct for the effects due to car speed, and centrifugal acceleration.

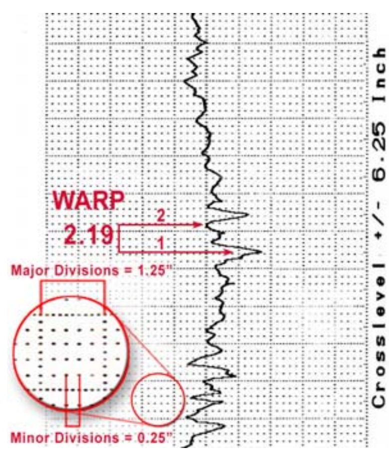



Crosslevel is then displayed on the 5$^{th}$ channel of the Astro-Med chart with a scale of ± 6.25 inches of elevation. A negative value indicate “left rail low” and a positive value indicates “right rail low”.

***Superelevation***: A constant elevation of the outside rail over the inner rail must be maintained on curves as well as a uniform rate of change on spirals and is measured in the same manner as crosslevel.

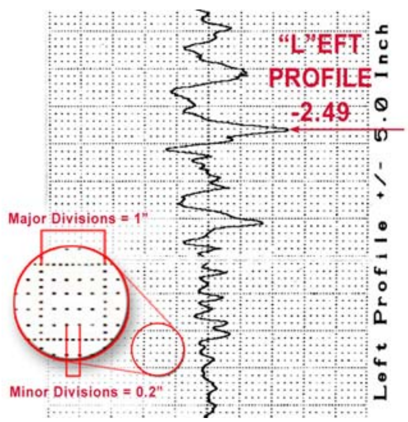
***Warp***: Relates to crosslevel measured diagonally from one end of a rail car to the other. Low spots under opposite ends of the car are not desirable. Warp is the rate of change in crosslevel along the track and is the difference in crosslevel between any two points (tangent, spiral or curve) 62-feet apart or less and is measured in the same manner as crosslevel.

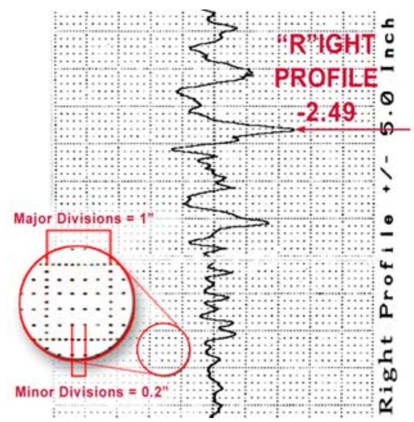
Warp is not displayed as a separate channel, but can be interpolated from the 5$^{th}$ channel (Crosslevel) as shown.



***Vertical*** *(Surface) Profile*: As crosslevel relates to transverse track elevation, profile relates to elevation along the longitudinal axis, that is, adherence to an established grade and the incidence of dips and humps. Profile of each rail is measured by the combination of two inertial accelerometers mounted vertically on the measurement beam and two vertical displacement measurements form the car-body to the axle. The signal from the accelerometers is processed to yield the up-and-down paths in space taken by the measurement beam. These paths are combined with the displacement measurements to form the vertical paths in space taken by the left and right wheels. Compensations for effects due to speed are made in software. The outputs can be represented in the form of a space curve or mid-chord offsets with respect to a selectable chord length.

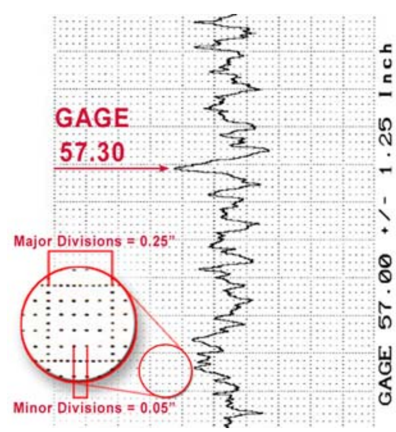
Profile is then displayed on the 1st and 3rd channels of the Astro-Med chart with a scale of $\pm$ 5 inches of profile. A negative value indicates a “rail low” condition on a “dip”. A positive value indicates a “rail high” condition on a “bump”.



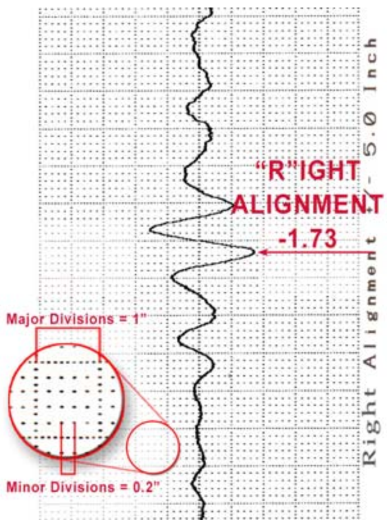

***Gage*****:** The inside distance between the gage corners of the rails is measured ⅝-inches below the top of the rail.

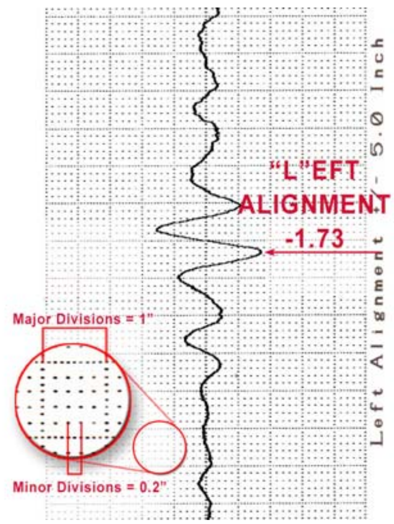
A Vision-Based High Speed Gage Measurement System (HSGMS) provides a gage measurement. The HSGMS system processes the image and provides the Track Geometry Measurement System (TGMS) a signal for left (LG) and right gage (RG). These signals are combined in the TGMS with the appropriate offset and scale factor to calculate gage. Gage is then displayed on the 7th channel of the Astro-Med chart displaying 55.75 inches to 58.25 inch



***Alignment***: Alignment of each rail is measured by the combination of an inertial sensing system and the gage system. An inertial accelerometer is mounted laterally inside the measurement beam. The signal from the accelerometer is processed to yield the lateral path in space taken by the truck. Compensations for effects due to speed, truck roll, and curving are made in software. The path of the truck is combined with the left and right gage measurements to form the alignment of each individual rail. The outputs are provided in the form of a space curve and mid-chord offsets with multiple chord outputs are provided in the form of a space curve and mid-chord offsets with multiple chord lengths.

Alignment is then displayed on the 2nd and 4th channels of the Astro-Med with a scale factor of ± 5 inches.




***Curvature***: The curvature measurement system determines track curvature by measuring the spatial rate of turn in the track. The system employs a rate-of-turn gyro to measure the temporal yaw rate. The temporal track yaw rate (in degrees per second) is converted to spatial track curving rate (in degrees per foot) by dividing train speed (in feet or meters per second) into it. Speed of the vehicle is provided by the speed and distance measurement system. The output of the curvature system, d = degree of curve, is scaled to a unit of degrees per 100 feet of track.

***Runoff***: A raise implies that during track maintenance, ***e.g.,*** track tamping or shimming a bridge, the work increases the elevation of the track above an original level. Maintaining proper runoff in tangents and curves, because of increased dynamic vertical and lateral loading, is crucial. Trains riding on track runoff (or run on) will experience a vertical pitch[3] or bounce[4] if the runoff is too abrupt or short and is measured, based on a 31-foot chord, in the same manner as profile.

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[3] Pitch of the carbody is the rotation about its transverse axis mass center.

[4] Bounce is the simple vertical oscillation of the body on its suspensions in which the car body remains horizontal.

## PUTTING DATA TO USE

Track geometry data is simultaneously recorded on hard disk and CD-ROM format. Additional analysis can be performed to provide detailed information such as track geometry space curves, track quality indices, and other track geometry descriptors. This data is used to support FRA's effort to develop performance-based track geometry standards. Data is also displayed on an oscillograph for immediate viewing and processed in real-time to produce the Track Geometry Exception Report containing four (4) sections.

- Exception Summary Section (Mile by Mile Summary)
- Exception List Section (Detailed Exception Report)
- Curve Analysis Section (Detailed Curve Analysis)
- Excerpts from 49 CFR Part 213
- Astro-Med Recording (Available upon request to Railroad only)
- Video Stripchart (Available to Railroad and FRA Inspectors)

These reports document the magnitude of any track exceptions, e.g., profile, crosslevel (Superelevation), warp, curvature, gage, and alignment. The detailed exception listings in this report provide FTSS information keyed to geographic location (i.e. distance from a milepost, or GPS latitude and longitude location). Federal and State Safety Inspectors use the reports as a tool to assess and insure compliance with Federal Track Safety Standards.


Railroad managers and maintenance planners use the reports to pinpoint sections of track that require maintenance, both short-range (days) and long-range (months) and to identify the types of maintenance actions required at specific locations, prepare work-crew schedules, and estimate future track maintenance workloads.

**EXAMPLES**

# AUTOMATED TRACK INSPECTION PROGRAM
## Exception List, Curve Analysis, and Exception Summary Reports

| AUTOMATED TRACK INSPECTION PROGRAM | | | | |
|---|---|---|---|---|
| **EXCEPTION LIST REPORT** | | | | |
| ***Railroad Name*** | | | | |
| | | | | |
| **Survey Number** | | | **DATE: July 28, 2003** | |
| | | | | |
| **Location From:** | | | **Milepost From:** | |
| | | | | |
| **Location To:** | | | **Milepost To:** | |

| Milepost | +Feet | Parameter | Value | Length | TSC | L / P Class | Track | Latitude | Longitude |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | State Line | | | | | | | |
| 0 | 2 | Class Chg | 1.00 | | | | | | |
| 0 | 2 | Track | 1.00 | | | | | | |
| 0 | 2 | State Line | 00 | | | | | | |
| 0 | 3 | Class Chg | 4.00 | | | | | | |
| 0 | 3 | State Line | CA | | | | | | |
| | | | | | | | | | |
| 0 | 181 | Class Chq | 2.00 | | | | | | |
| 0 | 512 | Class Chg | 3.00 | | | | | | |
| 579 | 4411 | Up MP | 579.00 | | | | | | |
| 579 | 1 | Class Chg | 4.00 | | | | | | |
| 579 | 295 | Class Chg | 1 3.00 | | | | | | |
| 579 | 1565 | Class Chg | 4.00 | | | | | | |
| | | | | | | | | | |
| 580 | 5089 | Up MP | 580,00 | | | | | | |
| 581 | 5444 | Up MP | 581.00 | | | | | | |
| 582 | 5188 | Up MP | 582.00 | | | | | | |
| 583 | 4790 | Up MP | 583.00 | | | | | | |
| 583 | 204 | Gage Wide | 57.72 | 2 | C | 3 4 | 1 | | |
| 583 | 436 | Gage Wide | 57.69 | 2 | C | 3 4 | 1 | | |

## EXCEPTION LIST REPORT KEY

| Column Heading | Description |
|---|---|
| MP | Milepost 4 digits Either Descending or Ascending |
| Feet | Feet Marked at End of Exception or at Manual Event.<br>Negative Feet = Descending milepost. Feet at MP parameter = Footage between Mileposts |
| Parameter | See Parameter Entry List |
| Value | Most Restrictive Computed Value in Exception Integers expressed as X.00 (MP, Trk, Cls, etc.) |
| Length | Total Length of Exception |
| T-S-C | **T**angent, **S**piral, or **C**urve Track Segment |
| L / P Class | L = Limiting Class of Track P = Posted Track Classification (According to Speed) |
| Track | Track Number Using ATIP Convention (See Compliance Manual, Chapter 3) |
| Latitude | DGPS Latitude, Corrected by Dead Reckoning Feature |
| Longitude | DGPS Longitude, Corrected by Dead Reckoning Feature |

Note: RQ = Ride Quality Runoff Exceptions are advisory information only

| AUTOMATED TRACK INSPECTION PROGRAM | | |
|---|---|---|
| CURVE ANALYSIS SUMMARY REPORT | | |
| | *Railroad Name* | |
| DATE: July 28, 2003 | | |
| **Survey Number:** | | |
| **Location FROM:** | **TO:** | TRACK NUMBER: |

| LOCATION | | | | | AVERAGE | | | | LIMITING PARAMETERS | | | | | | LIMITING SPEED | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Starting | | Ending | | Total | Curve | Elevation | Speed | | Location | | Curve | Elevation | Total | | Unbalance (Inches) | | | | | |
| MP | +Feet | MP | +Feet | Length | Deg/Min | Inches | Post | Limit | MP | Feet | Deg/Min | Inches | Feet | Grp | 4 | 5 | 6 | 7 | 8 | 9 |
| | | | | | | | | | | | | | | | | | | | | |
| 588 | 2184 | 588 | 3471 | 1287 | 2/31 | 2.82 | 50 | 56 | 588 | 2845 | 2/33 | 2.79 | 0 | 0 | 61 | 65 | 70 | 73 | 77 | 81 |
| 588 | 147 | 588 | 1338 | 1191 | 3/41 | 4.02 | 50 | 50 | 588 | 674 | 3139 | 3.58 | 0 | 0 | 54 | 57 | 61 | 64 | 67 | 70 |
| 588 | 4819 | 590 | 1892 | 2289 | -1/27 | -1.76 | 50 | 66 | 590 | 392 | -1/28 | -1,61 | 0 | 0 | 73 | 80 | 86 | 91 | 96 | 101 |
| 591 | 1613 | 591 | 3176 | 1563 | -0/43 | -0.74 | 65 | 81 | 591 | 2657 | -0/47 | -0.73 | 0 | 0 | 92 | 101 | 110 | 118 | 125 | 132 |
| 592 | 3593 | 593 | 467 | 2107 | 2/0 | 2.68 | 65 | 62 | 592 | 4350 | 2/1 | 2.60 | 1351 | 1 | 68 | 73 | 77 | 82 | 86 | 90 |
| 593 | 1690 | 593 | 4287 | 2597 | -5/57 | -2.75 | 30 | 36 | 593 | 2699 | -5/59 | -2.59 | 0 | 0 | 39 | 42 | 45 | 47 | 50 | 52 |
| | | | | | | | | | | | | | | | | | | | | |
| 594 | 2752 | 594 | 5345 | 2560 | -5/55 | -2.75 | 60 | 36 | 594 | 3765 | -5157 | -2.56 | 1257 | 1 | 39 | 42 | 45 | 47 | 50 | 52 |
| 594 | 3892 | 594 | 1128 | 2459 | 1/31 | 1.81 | 60 | 63 | 594 | 541 | 1/31 | 1.34 | 0 | 0 | 70 | 77 | 83 | 88 | 93 | 98 |
| 596 | 3042 | 596 | 4797 | 1755 | 1/2 | 1.27 | 60 | 74 | 596 | 4143 | 1/6 | 1.26 | 0 | 0 | 82 | 90 | 97 | 103 | 109 | 115 |
| 597 | 265 | 597 | 1160 | 895 | -0/54 | -1.16 | 60 | 79 | 597 | 824 | -0/55 | -1.10 | 0 | 0 | 88 | 96 | 104 | 111 | 118 | 124 |
| 597 | 4541 | 598 | 526 | 1321 | -1/56 | -3.30 | 60 | 66 | 597 | 5173 | -1/58 | -3.20 | 0 | 0 | 72 | 77 | 81 | 85 | 90 | 94 |
| 598 | 1078 | 598 | 2884 | 1806 | 1/31 | 2.14 | 60 | 68 | 598 | 2154 | 1/34 | 2.17 | 0 | 0 | 74 | 80 | 86 | 91 | 96 | 100 |

## CURVE ANALYSIS REPORT KEY

| Column Heading | Description |
|---|---|
| Starting (MP) Milepost | Beginning Milepost of Curve |
| Starting (Dist) Distance | Beginning Feet of Curve |
| Ending MP | Ending Milepost of Curve |
| Ending Dist. | Ending Feet of Curve |
| Length | Total Length of Curve in Feet |
| Average Curv Deg/ Min | Average Curvature in Degrees/Minutes |
| Average Elev | Average Elevation in Inches |
| Speed Post | Posted Speed |
| Speed Lmt | Limiting Speed (Based on Entered Unbalance Value, Currently 3”) |
| Limiting Point MP | Milepost of Most Limiting Point |
| Limiting Point Feet | Foot Count from Recorded Milepost of Most Limiting Point |
| Limiting Point Curve Deg/Min | Curvature in Degrees /Minutes of Most Limiting Point |
| Limiting Point Elev Inches | Elevation in Inches of Most Limiting Point |
| Total Ft | Total Limiting Feet in Curve |
| Total Grp | Total of Limiting Groups of Limiting Points in Curve |
| Limiting Speed At 4 | Speed Based upon 4-Inches of Unbalance |
| Limiting Speed At 5 | Speed Based upon 5-Inches of Unbalance |
| Limiting Speed At 6 | Speed Based upon 6-Inches of Unbalance |
| Limiting Speed At 7 | Speed Based upon 7-Inches of Unbalance |
| Limiting Speed At 8 | Speed Based upon 8-Inches of Unbalance |
| Limiting Speed At 9 | Speed Based upon 9-Inches of Unbalance |

Note: Positive (+) Negative (-) Values Under Crosslevel, Curvature, Profile And Alignment Headings--Relate To Left And Right Rails, Respectively, Determined By Vehicle Forward or Reverse Direction While Surveying. Crosslevel: Plus (+) = Left Rail High Minus (-) = Right Rail High **Curvature: Plus (+) = Curve to Right Minus (-) = Curve to Left**

| AUTOMATED TRACK INSPECTION PROGRAM | | | |
|---|---|---|---|
| ONE MILE BY CLASS OF TRACK SUMMARY REPORT | | | |
| | *Railroad Name* | | DATE: July 28, 2003 |
| SURVEY NUMBER: | | | PAGE |
| LOCATION FROM: | | TO: | |
| MILEPOST FROM | | | |
| MILEPOST To: | | | |

| Location | | Profile | | | Alignment | | | Gage | | | Crosslevel[5] | | | Warp | | | Classification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Milepost | +FEET | Total Exception | Exception Feet | Class Exception | Total Exception | Exception Feet | Class Exception | Total Exception | Exception Feet | Class Exception | Total Exception | Exception Feet | Class Exception | | Exception Feet | Class Exception | Limiting Class | Posted Class | Track # |
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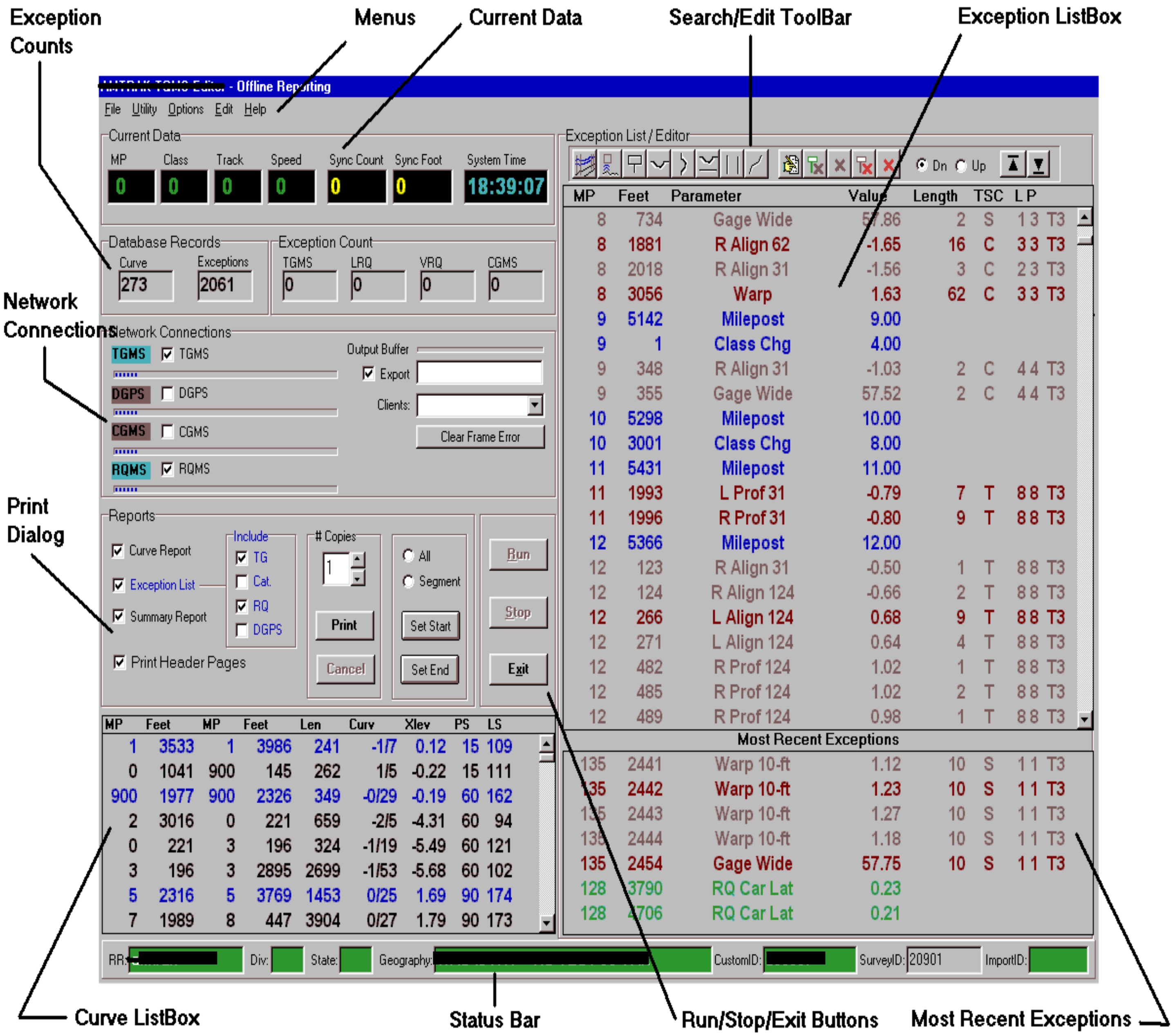
## ONE MILE BY CLASS OF TRACK SUMMARY REPORT KEY

| **Column Heading** | Description |
|---|---|
| MP | Mile of Interest |
| FT | Total Foot Count of Mile |
| Profile Tot Exc | Total Profile Exceptions in Mile |
| Profile Exc Ft | Total Profile Exception Feet in Mile |
| Profile CL 1 Exc | Total Class 1 Profile Exceptions in Mile |
| Align Tot Exc | Total Alignment Exceptions in Mile |
| Align Exc Ft | Total Alignment Exception Feet in Mile |
| Align CL 1 Exc | Total Class 1 Alignment Exceptions in Mile |
| Gage Tot Exc | Total Gage Exceptions in Mile |
| Gage Exc Ft | Total Gage Exception Feet in Mile |
| Gage CL 1 Exc | Total Class 1 Gage Exceptions in Mile |
| Xlevel Tot Exc | Total Crosslevel Exceptions in Mile |
| Xlevel Exc Ft | Total Crosslevel Exception Feet in Mile |
| Xlev CL 1 Exc | Total Class 1 Crosslevel Exceptions in Mile |
| Warp Tot Exc | Total Warp Exceptions in Mile |
| Warp Exc Ft | Total Warp Exception Feet in Mile |
| Warp CL 1 Exc | Total Class 1 Warp Exceptions in Mile |
| Limit Class | Most Limiting Class in Mile |
| Posted Class | Posted Class in Mile or Mile Segment |
| Track | Track Number of Mile or Mile Segment |

[5] Excess Elevation, Reverse Elevation, Runoff, And Rock Off Totals, Included In Crosslevel Heading.

# EDITOR SCREEN DISPLAY




The Editor Screen allows the Track Inspector and Data Specialist to monitor system functions, curve data and track Geometry exceptions.

**Excerpts from**

# UNITED STATES DEPARTMENT OF TRANSPORTATION
## Federal Railroad Administration

**49 CFR Part 213 Subpart A-F**
**Track Class 1 Through 5**

**And**

**49 CFR Part 213 Subpart G**
**Track Class 6 through 9**

**UNITED STATES DEPARTMENT OF TRANSPORTATION**
**Federal Railroad Administration**
**Excerpt from 49 CFR Part 213 Subpart A-F**
**Track Class 1 through Track Class 5**

### § 213.53 Gage.

(a) Gage is measured between the heads of the rails at right angles to the rails in a plane five-eighths of an inch below the top of the railhead.
(b) Gage shall be within the limits prescribed in Table 3:

| Class of Track | Must be at least | But not more than |
|---|---|---|
| Excepted | N/A | 4 feet 10¼ -inches |
| Class 1 | 4-feet 8-inches | 4 feet 10-inches |
| Class 2 and 3 | 4-feet 8-inches | 4 feet 9¾ -inches |
| Class 4 and 5 | 4-feet 8-inches | 4 feet 9½ -inches |

Table 3

### § 213.55 Alignment.

Alignment may not deviate from uniformity more than the amount prescribed in Table 4:

| Class of Track | Tangent Track | Curved Track | |
|---|---|---|---|
| | The deviation of the mid-offset from a 62-foot line may not be More than- (inches) Note 1 | The deviation of the mid-ordinate from a 31-foot chord may not be more than- (inches) Note 2 | The deviation of the mid-ordinate from a 62-foot chord may not be more than (inches) Note 2 |
| Class 1 Track | 5 | Note 3 | 5 |
| Class 2 Track | 3 | Note 3 | 3 |
| Class 3 Track | 1 ¾ | 1 ¼ | 1 ¾ |
| Class 4 Track | 1 ½ | 1 | 1 ½ |
| Class 5 Track | ¾ | ½ | ⅝ |

Table 4

Notes: 1. The ends of the line shall be at points on the gage side of the line rail, five-eighths of an inch below the top of the railhead. Either rail may be used as the line rail; however, the same rail shall be used for the full length of that tangential segment of track.
2. The ends of the chord shall be at points on the gage side of the outer rail, five-eighths of an inch below the top of the railhead.
3. N/A-Not Applicable.

### § 213.57 Curves; elevation and speed limitations.

(a) The maximum crosslevel on the outside rail of a curve may not be more than 8 inches on track Classes 1 and 2 and 7 inches on Classes 3 through 5. Except as provided in § 213.63, the outside rail of a curve may not be lower than the inside rail.
(b) (1) The maximum allowable operating speed for each curve is determined by the following formula:

$$V \max = -\sqrt{((Ea + 3)/(0.0007 * D))}$$

(c)(1) For rolling stock meeting the requirements specified in paragraph (d) of this section, the maximum operating speed for each curve may be determined by the following formula:

$$V \max = -\sqrt{((Ea + 4)/(0.0007 * D))}$$

Where: $V_{max}$ = Maximum allowable operating speed (miles per hour)
Ea = Actual elevation of the outside rail (inches)[6]
D = Degree of curvature (degrees).[7]

### § 213.59 Elevation of curved track; runoff.

(a) If a curve is elevated, the full elevation shall be provided throughout the curve, unless physical conditions do not permit. If elevation runoff occurs in a curve, the actual minimum elevation shall be used in computing the maximum allowable operating speed for that curve under § 213.57(b).

(b) Elevation runoff shall be at a uniform rate, within the limits of track surface deviation prescribed in §213.63 and it shall extend at least the full length of the spirals. If physical conditions do not permit a spiral long enough to accommodate the minimum length of runoff, part of the runoff may be on tangent track.

### § 213.63 Track surface.

Each owner of the track to which this part applies shall maintain the surface of its track within the limits prescribed in Table 5:

| Track surface | Class of Track | | | | |
|---|---|---|---|---|---|
| | 1 (Inches) | 2 (Inches) | 3 (Inches) | 4 (Inches) | 5 (Inches) |
| The runoff in any 31 feet of rail at the end of a raise may not be more than | 3 ½ | 3 | 2 | 1 ½ | 1 |
| The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than. | 3 | 2 ¾ | 2 ¼ | 2 | 1 ¼ |
| The deviation from zero crosslevel at any point on tangent or reverse crosslevel elevation on curves may not be more than... | 3 | 2 | 1 ¾ | 1 ¼ | 1 |
| The difference in cross level between any two points less than 62 feet apart may not be more than *, 1, 2 … | 3 | 2 ¼ | 2 | 1 ¾ | 1 ½ |
| * Where determined by engineering decision prior to the promulgation of this rule, due to physical restrictions on spiral length and operating practices and experience, the variation in crosslevel on spirals per 31 feet may not be more than … | 2 | 1 ¾ | 1 ¼ | 1 | ¾ |

Notes:
[1] Except as limited by § 213.57(a), where the elevation at any point in a curve equals or exceeds 6 inches, the difference in crosslevel within 62 feet between that point and a point with greater elevation may not be more than 1-½ inches.

[2] However, to control harmonics on Class 2 through 5 jointed track with staggered joints, the crosslevel differences shall not exceed 1-¼ inches in all of six consecutive pairs of joints, as created by 7 low joints. Track with joints staggered less than 10 feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints for purposes of this footnote.

**Table 5**

[6] Actual elevation for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 10 points through the segment at 15.5 foot spacing. If the curve length is less than 155-feet, average the points through the full length of the body of the curve.
[7] Degree of curvature is determined by averaging the degree of curvature over the same track segment as the elevation.

**UNITED STATES DEPARTMENT OF TRANSPORTATION**
**Federal Railroad Administration**
**Excerpts from 49 CFR Part 213 Subpart G**
**Track Class 6 through Track Class 9**

## § 213.323 Gage

(a) Gage is measured between the heads of the rails at right angles to the rails in a plane five-eighths of an inch below the top of the railhead.

(b) Gage shall be within the limits prescribed in Table 6:

| Class of Track | Must be at least | but not more than | Change in 31 ft |
|---|---|---|---|
| **6** | **4-feet 8-inches** | **4-feet 9¼-inches** | **½-inches** |
| **7** | **4-feet 8-inches** | **4-feet 9¼-inches** | **½-inches** |
| **8** | **4-feet 8-inches** | **4-feet 9¼-inches** | **½-inches** |
| **9** | **4-feet 8-inches** | **4-feet 9¼-inches** | **½-inches** |

Table 6

## § 213.327 Alignment

(a) Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine (9) consecutive points centered around that point and which are spaced according to Table 7:

| Chord length | Spacing |
|---|---|
| 31-feet | 7-feet 9-inches |
| 62-feet | 15-feet 6-inches |
| 124-feet | 31-feet 0-inches |

Table 7

(b) For a single deviation, alignment may not deviate from uniformity more than the amount prescribed in Table 8:

| Class of track | The deviation from uniformity of the mid-chord offset for a 31-foot chord may not be more than (inches) | The deviation from uniformity of the mid-chord offset for a 62-foot chord may not be more than (inches) | The deviation from uniformity of the mid-chord offset for a 124-foot chord may not be more than (inches) |
|---|---|---|---|
| 6 | ½ | ¾ | 1 ½ |
| 7 | ½ | ½ | 1 ¼ |
| 8 | ½ | ½ | ¾ |
| 9 | ½ | ½ | ¾ |

Table 8

(c) For three or more non-overlapping deviations from uniformity in track alignment occurring within a distance equal to five times the specified chord length, each of which exceeds the limits in the following table, each owner of the track to which this subpart applies shall maintain the alignment of the track within the limits prescribed for each deviation, as shown in Table 9:

| Class of track | The deviation from uniformity of the mid- chord offset for a 31-foot chord may not be more than (inches) | The deviation from uniformity of the mid- chord offset for a 62-foot chord may not be more than (inches) | The deviation from uniformity of the mid- chord offset for a 124- foot chord may not be more than (inches) |
|---|---|---|---|
| 6 | ⅜ | ½ | 1 |
| 7 | ⅜ | ⅜ | ⅞ |
| 8 | ⅜ | ⅜ | ½ |
| 9 | ⅜ | ⅜ | ½ |

Table 9

**UNITED STATES DEPARTMENT OF TRANSPORTATION**
**Federal Railroad Administration**
**Excerpts from 49 CFR Part 213 Subpart G**
**Track Class 6 through Track Class 9**

## § 213.329 Curves, elevation and speed limitations.

(a) The maximum crosslevel on the outside rail of a curve may not be more than 7 inches. The outside rail of a curve may not be more than ½ inch lower than the inside rail.

(b)(1) The maximum allowable operating speed for each curve is determined by the following formula:

(b)(2) Appendix A (not included)

$$V\ \max = -\sqrt{((Ea + 3)/(0.0007 * D))}$$

(c) For rolling stock meeting the requirements specified in paragraph (d) of this section, the maximum operating speed for each curve may be determined by the following formula:

$$V\ \max = -\sqrt{((Ea + Eu)/(0.0007 * D))}$$

Where:

$V_{max}$ = Maximum allowable operating speed (miles per hour)
$E_a$ = Actual elevation of the outside rail (inches)[8]
$E_u$ = Unbalanced elevation in (inches)
D = Degree of curvature (degrees).[9]
3 = 3-inches of unbalance

[8] Actual elevation for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 10 points through the segment at 15.5 foot spacing. If the curve length is less than 155 feet, average the points through the full length of the body of the curve. If $E_u$ exceeds 4-inches, the $V_{max}$ formula applies to the spirals on both ends of the curve.

[9] Degree of curvature is determined by averaging the degree of curvature over the same track segment as the elevation.

## § 213.331 Track surface

1) For a single deviation in track surface, each owner of the track to which this subpart applies shall maintain the surface of its track within the limits prescribed in the following table

| Track Surface (inches) | Class 6 | Class 7 | Class 8 | Class 9 |
|---|---|---|---|---|
| The deviation from uniform[10] profile on either rail at the mid-ordinate of a 31- foot chord may not be more than… | 1 | 1 | ¾ | ½ |
| The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than… | 1 | 1 | 1 | ¾ |
| The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot chord may not be more than… | 1¾ | 1½ | 1¼ | 1¼ |
| The difference in crosslevel between any two points less than 62 feet apart may not be more than[11] … | 1½ | 1½ | 1½ | 1½ |

2) For three or more non-overlapping deviations in track surface occurring within a distance equal to five times the specific chord length, each of which exceeds the limits in the following table, each owner of the track…within the limits prescribed for each deviation:

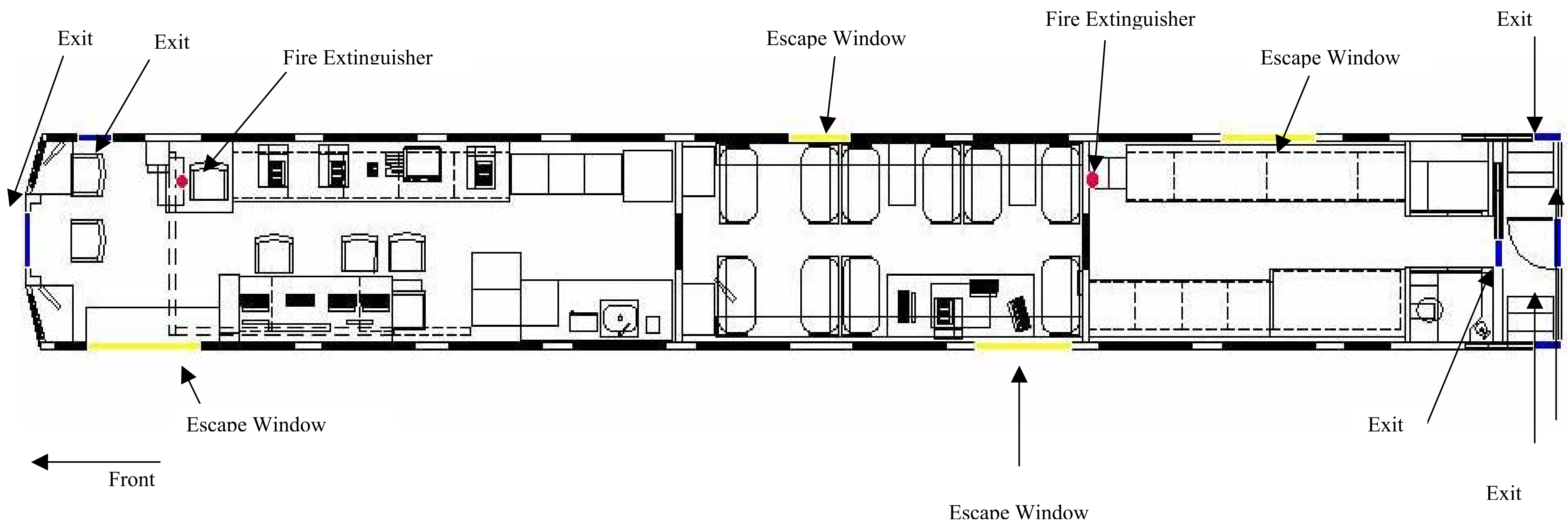
| Track Surface (inches) | Class 6 | Class 7 | Class 8 | Class 9 |
|---|---|---|---|---|
| The deviation from uniform profile on either rail at the mid-ordinate of a 31-foot chord may not be more than… | ¾ | ¾ | ½ | ⅜ |
| The deviation from uniform profile on either rail at the mid-ordinate of a 62-foot chord may not be more than… | ¾ | ¾ | ¾ | ½ |
| The deviation from uniform profile on either rail at the mid-ordinate of a 124-foot chord may not be more than… | 1 ¼ | 1 | ⅞ | ⅞ |

[10] Uniformity for profile is established by placing the midpoint of the specified chord at the point of maximum measurement

[11] However, to control harmonics on jointed track with staggered joints, the crosslevel differences shall not exceed 1-¼ inches in all of six consecutive pairs of joints, as created by 7 joints. Track with joints staggered less than 10-feet shall not be considered as having staggered joints. Joints within the 7 low joints outside of the regular joint spacing shall not be considered as joints.

# AUTOMATED TRACK INSPECTION PROGRAM

# FRA T16 SPECIFICATIONS



# AUTOMATED TRACK INSPECTION PROGRAM

## FRA T16 VEHICLE SYSTEM

| | |
|---|---|
| Type: | Tow behind Metroliner cab |
| Brakes: | Knorr Disk Brakes with Anti-skid; Parking Brake with Manual Override, Capable Service Brake Rate of 2.2 MPHPS, and an Emergency Rate of 2.8 MPHPS |
| Communications | Internal Public Address, cellular telephone, and (2) hand held radios. |
| Defect Marking | DGPS Reporting |

DIMENSIONS AND WEIGHTS

Weight, w/ Fuel ...................................... 125,000 pounds (62.5 tons)
Loading Each Axle ...................................... 31,250 pounds

**Seating: Seating for 26 People (Including Engineer); Rear Observation (3); Computer Room (3)**

Length Over Pulling Force of Couplers (PFC) ............................... 85’ 4”
Truck Center Distance .................................................... 59’ 6”
Truck Wheelbase ...................................... 8’ 6”
Maximum Length Carbody ...................................... 82’ 6”
Maximum Width Carbody ...................................... 10’ 4.375”
Maximum Height - Rail to Top of Satellite Antenna,
New Wheels, Light Car ...................................... 14’ 1”
Height, Rail to Top of Finished Floor ...................................... 52 ¾”
Wheel Diameter (New) ...................................... 36”
Fuel Capacity .................................................................................. 250 U.S. gallons

ACCOMMODATIONS

| | |
|---|---|
| Safety Equipment | First Aid Kits; Evacuation Tools; Fire Extinguishers; Derails; Wheel Chocks; Blue Flags and Lights; Personal Protection Equipment (safety vests, eyewear, hard hat, etc.); Portable “walkie-talkies” |

## AUTOMATED TRACK INSPECTION PROGRAM
## SUMMARY OF GEOMETRY VEHICLE MEASUREMENT CAPABILITIES

| System | Measured Range | Speed Range (MPH) | Processing Mode | | Laboratory Accuracy | Repeatability (inches) | |
|---|---|---|---|---|---|---|---|
| | | | Forward | Reverse | | Mean | Standard Deviation |
| Distance (miles) | 9,999.9 (optical) | 0-125+ | Yes | Yes | 5 feet/mile | N/A | N/A |
| Speed | 0-200 mph | 0-125+ | Yes | Yes | 2% but not < 2mph | N/A | N/A |
| Location (ALD) | Magnetic | 0-125+ | Yes | **Yes** | 100% Detection | N/A | N/A |
| Gage (normal rail Section) | 55 ½ to 58 ½" | 0-125+ | Yes | Yes | 1/32 Inch | 1/32 | 1/16 |
| Left or Right Curvature | ± 20 Degrees | 4-125+ | Yes | Yes | 0.2 Degrees/ 100' chord | 0.01 Degrees/ 100' chord | 0.15 Degrees/ 100' chord |
| Crosslevel | Up to 10 Inches | 0-125+ | Yes | Yes | 1/16 Inch | 1/32 | 1/16 |
| Profile (Inertial) | ± 5 inch | 5-125+ | Yes | Yes | 1/16 Inch | 1/32 | 1/16 |
| Alignment | ± 6.25 inch | 15-125+ | Yes | Yes | 1/8 Inch | 1/32 | 1/8 |
| Warp | ± 20 inch | 4-125+ | Yes | Yes | 1/8 Inch | N/A | N/A |
| Limiting Speed | 0-150 mph | 4-125+ | Yes | Yes | N/A | N/A | N/A |
| Ride Quality | ± .25g | 0-125+ | Yes | Yes | 1/64 g's | N/A | N/A |
| DGPS † | Long-360" Lat ± 90" | 0-125+ | Yes | Yes | 3-10 Feet | N/A | 5-Feet |

Table 10

N/A = Not Applicable
† = Differential Global Positioning System

## TYPICAL CREW COMPLEMENT

FRA inspectors are assigned to ensur compliance with applicable Federal and railroad rules. The primary purpose of this assignment activity is to assure the geometry vehicle is operated safely, in accordance with FRA policy, railroad operating rules, and that individual railroad track is being maintained, inspected, and complies with the FTSS.

Each of FRA's eight regions is represented by a Track or Operating Practices (OP) inspector, onboard the geometry vehicle. Normally, the planned survey route is the assigned duty location and responsibility of the inspectors. The senior onboard FRA track inspector will be the final decision-making authority on the proper course of action for preparation and overall supervision of ATIP surveys. The senior onboard OP inspector will be the final decision-making authority on the proper course of action for the safe operational management of the vehicle.

FRA track inspectors are responsible for monitoring and assessing more than 190,000 railroad track miles. ATIP assists inspectors in meeting this responsibility and in so doing, requires the inspector to interpret and verify first-hand, the data collected and for relating FTSS exceptions to the surveyed track. The inspector is required to ride the geometry vehicle to permit real-time interpretation of analog, video, and printed outputs. This allows the track inspector to:

- Immediately discuss questionable track geometry exceptions with the onboard railroad representatives,
- Conduct manual on-the-ground inspections to verify measurable inputs,
- Insure proper and immediate remedial action is taken to halt or slow train operations on any portion of track containing a severe safety problem and,
- Observe track and right-of-way conditions (*e.g.,* vegetation obstructing visibility of signals and at highway-rail crossings) and detect FTSS exceptions not measured by the geometry vehicle measurement system.

The contractor assists both the FRA OP and Track inspectors in the monitoring of authorized speed accuracy according to reported track classification. Geometry vehicle speed will be monitored to indicate speedometer accuracy (timed checks) at suitable locations against all authorized timetable and track bulletin information, submitted by the railroad, as it applies to current track classification and related assigned speed values of authorized train movement.

### RAILROAD REPRESENTATIVE

The Railroad Representative is usually someone with supervisory responsibility for track maintenance of the track being surveyed.

### RAILROAD ENGINEER

The Locomotive Engineer is required to be certified and qualified on the physical characteristics of the track being surveyed.

### CONTRACTOR EMPLOYEES

On behalf of the FRA, the contractor employees operate and maintain the government-furnished geometry car safely and efficiently, accurately record track geometry data, perform corrective and preventive maintenance work, make the necessary adjustments, and all activities required to keep the geometry car's equipment and instrumentation in an operational, safe, clean and orderly condition. The recommended number of personnel on the car during operations is eight to ten in the FRA T16 plus three to four in the Locomotive cab.

# ENCLOSURE A

**FRA T16 OPERATING DIRECTIVES**
Federal Railroad Administration (FRA), Office of Safety—Automated Track Inspection Program (ATIP), manages a railbound high-speed vehicle[12] (consist designated as FRA T16) to measure track geometry for compliance with the *Federal Track Safety Standards* nationwide. Towed exclusively by a railroad-owned locomotive and train crew, FRA T16 operating directives, are as follows:

**OPERATION**

1) A copy of this enclosure must be furnished to each cognizant Train Dispatcher, Conductor and Locomotive Engineer.

2) Before ATIP survey operations, the Survey Director is responsible for overall safety and will: (1) conduct a face-to-face safety briefing with the train crew and all occupants of the FRA T16 concerning onboard safety appliances and standard operating procedures, (2) recognize and adapt to applicable operational and safety conditions, and on-track protection procedures, that may change throughout the course of the ATIP survey affecting everyone, and (3) ensure that proper equipment is onboard for signaling.

3) Before ATIP survey operations, FRA safety inspectors will communicate directly with the Train Dispatcher and Locomotive Engineer, to ensure that all operating rules in effect on the survey route are understood. Reference to current and applicable operating documents (Timetable, Special Instruction, General Order, Track Bulletin or similar documents) will confirm dispatching and operational information. FRA safety inspectors will be stationed wherever the method of operation, procedures, and movement allows monitoring.

4) FRA T16 must not exceed a maximum speed of 125 mph and is not restricted by special trackwork.

5) To verify instrument measurement precision, and determine compliance with the *Federal Track Safety Standards,* FRA T16 may stop en route or reverse movement (back up) for short distances while occupying a block. Any reverse movement will be conducted, in accordance with the railroad's operating rules and special instructions. As such, all mandatory directives governing this movement will be transmitted and received in compliance with railroad rules and special instructions. FRA T16 is not required to be stopped while passing or being passed by a train on an adjacent track.

6) Interlocking and/or Control Point Operators will not change the position of any switch or indication of any signal, until they are informed that the FRA T16 is clear of the interlocking or control point or a section thereof. If the FRA T16 is stopped within the limits of any interlocking or control point, the Train Dispatcher or Control Operator will be notified of the stop and the precise location. FRA T16 will not make a controlled stop within the limits of an automatic interlocking or a non-interlocked at grade railroad crossing.

7) In automatic block signal system or traffic control system territory, FRA T16 should avoid stopping on sand or other similar rail surface conditions affecting the shunting of the track circuit. If such a stop cannot be avoided, FRA T16 will immediately move a sufficient distance to clear that affected portion of the rail. Track and signal maintenance conditions vary, and may cause non-shunting. Where provided, electrical or mechanical blocking devices will be used on switch and signal controls to protect against opposing and following movements.

**PROTECTION**

8) Neither FRA nor contractor employees will operate a railroad switch or derail and will rely upon a railroad employee to perform that function. When conducting ATIP surveys and after receiving authority for placement from the appropriate railroad representative, protective devices owned by FRA, *i.e.,* signs, derails, and locking devices, will be applied by contractor employees.

[12] One or Two Tier I passenger equipment

9) On-ground protection against highway vehicles will be provided when: (1) highway-rail automatic warning devices fail to fully activate, (2) FRA T16 interferes[13] with the normal function of the warning devices, or (3) when prescribed by railroad rules or special instructions.

10) Either on a main track or other than main track, before anyone goes on, under or between FRA T16, the Locomotive Engineer will initiate positive protection, *i.e.,* place the brakes in emergency position and *surrender* the locomotive reverser. As directed by the Survey Director, a 'blue signal' will be displayed at a readily visible location on the locomotive control stand and may only be removed by the person who displayed the safety device.

**SECUREMENT**

11) Within a locomotive servicing area or car shop area, the railroad's blue signal rules will govern before anyone goes on, under or between FRA T16. Only after approval by the FRA and authorization by the railroad employee-in-charge of workers, may FRA T16 be repositioned.

12) During active or inactive ATIP survey status, Roadway Worker Protection (RWP) rules will govern, and afford anyone, performing roadway worker duties, equivalent on-track protection.

13) When FRA T16 is unoccupied and at the request of FRA, protection (posted guards) will be provided by the railroad. Under no circumstance, will FRA T16 be relocated or coupled to other rolling equipment without permission by the FRA. At the request of the FRA or railroad, additional protective measures (as outlined below) maybe utilized.

14) Where provided, a remotely controlled switch, providing entrance to the track occupied by FRA T16, will be aligned <u>against</u> movement to that track. Electrical blocking devices, applied by the Control Operator, will be placed on the switch and signal controls to prevent undesirable access.

15) A manually operated switch will be aligned <u>against</u> movement to a track occupied by the FRA T16 and secured with an effective mechanical locking device, exclusive to FRA. In addition, the switch stand's operating mechanism will be equipped with a visible all-weather display tag warning any users, "**Out of Service—Do Not Operate.**"

16) If neither an effective electrical nor a mechanical switch-locking device cannot be aligned and locked, as described above, **derails** capable of restricting access in either direction will be used as an alternative. In addition to the derails, the placement[14] of "portable train control" warning signs will be displayed in the center of the track, indicating the presence of FRA T16. The warning signs will consist of a metal 16×24-inch red reflectorize placard (track flag) affixed near the derail**;** signifying rolling equipment cannot couple to or be moved. One wheel of FRA T16 consist will be securely <u>chocked</u> to prevent movement on its own.

[13] §234.205 Grade Crossing Signal System Safety

[14] Protective devices, owned by FRA, will not be placed nearer than 150-feet from each end of the FRA T16, except where appropriate.

# ENSCO'S GENERAL SAFETY RULES

**A. Safety is the first consideration in the performance of your duty**

**B. Knowledge and obedience of the rules contained herein is essential to safety**

**C. ENSCO employees shall act in a professional and courteous manner at all times**

**D. In case of doubt or uncertainty in work procedures and practices, the safest course must be taken**

**E. Never assume that any safety device or procedure protects you, unless you have direct knowledge the device is in use or the procedure is being followed**

**F. ENSCO employees are required to have a copy of these rules while on duty and must understand and obey them. Questions regarding these rules shall be directed to the ENSCO Safety Officer or alternate for an explanation**

**G. The use of or being under the influence of intoxicants, narcotics, or dangerous drugs by ENSCO employees when on duty or when subject to duty, is prohibited. Possession of intoxicants, narcotics, or dangerous drugs or participation in any transaction involving the same by employees on duty or on Government or railroad property is prohibited and subject to disciplinary action, including dismissal. The use of any medication, including those prescribed or dispensed by physicians, that will affect an employee's alertness, coordination, reaction, judgment, vision, or ability to perform their work properly will be reported to the Safety Officer or alternate. Persons affected will be relieved of hazardous assignments**

**H. Everyone assigned to or visiting the survey cars must receive a safety briefing by the Survey Director or alternate, covering the rules or procedures that must be observed while on or about the survey vehicles**

**I. Any violation of these rules or any unsafe condition should be reported promptly to the Safety Officer or alternate**

**J. Employees who persist in unsafe practices and place themselves or others in jeopardy will be subject to disciplinary action, including dismissal**

**K. Employees must not rely solely upon the carefulness of others, but must protect themselves when their own safety is involved**

###


**Requests for further information on the use of these systems,
Or additional data related to the data collection techniques
Described, should be addressed to:**

**The Associate Administrator for Safety
Federal Railroad Administration
1120 Vermont Avenue NW
Washington, DC 20005**

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA